

Fire Extinguisher

Some fires can be extinguished by smothering them with carbon dioxide gas (CO_2). A company is designing a fire extinguisher that uses the chemical reaction between vinegar and baking soda to produce carbon dioxide. Since the fire extinguisher must produce the gas quickly in order to put out a fire, the designers need your help in studying variables that affect how much carbon dioxide this reaction produces in a certain amount of time.

There are several variables that may affect the rate of carbon dioxide production in the fire extinguisher, such as the amount of baking soda, the concentration of vinegar solution, and the temperature of the vinegar solution. You will investigate two of these variables using a plastic bottle as a model fire extinguisher.

Your model fire extinguisher should only hold a maximum of 10 cc (cubic centimeters) of vinegar solution. Note: 1 cc = 1 mL.

Your task:

Part I: You and your partner will design and conduct an experiment to determine how the *amount of baking soda* affects how much carbon dioxide is produced in a *certain amount of time*.

Part II: You and your partner will design and conduct an experiment to determine how *another variable* that you choose affects how much carbon dioxide is produced in a *certain amount of time*.

During the activity, you will work with a partner (or possibly two partners). Each of you must keep your own lab notes because after you finish you will work by yourself to write a report about your investigation.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided. You may use additional materials and equipment if they are available.

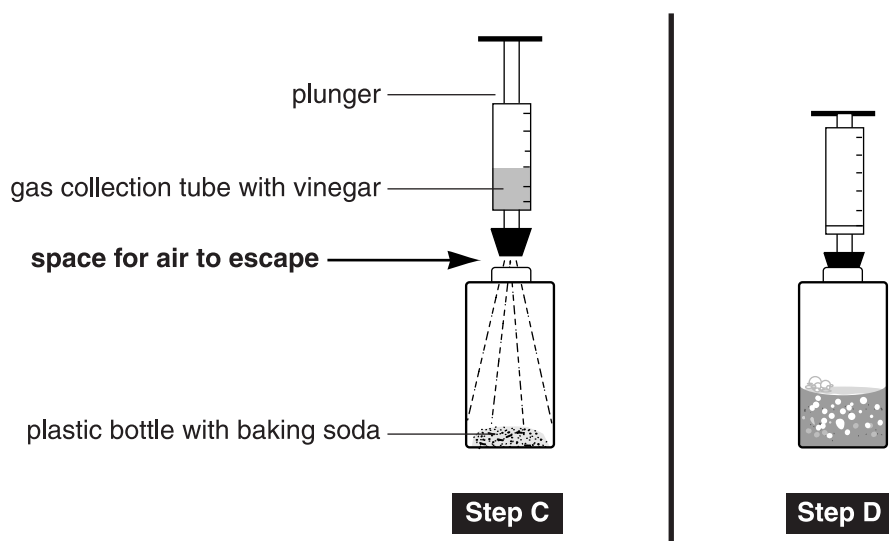
Baking soda	1 Thermometer
Vinegar	1 Graduated cylinder
1 Plastic bottle	Access to a watch or clock with a second hand
1 Gas collection tube	Access to water
1 Rubber stopper	Access to a balance
1 Small scoop	Splash-proof safety goggles
5 Plastic cups	Aprons
Access to hot and cold water baths	

Steps to follow:

PART I

1. **State** the problem you are going to investigate. Clearly identify the *independent* and *dependent* variables that will be studied. Write your problem statement on page 5.
2. **Design** an experiment to solve the problem. Your experimental design should match the statement of the problem, should control for variables and should be clearly described so that someone else could replicate your experiment. Use a control and perform multiple trials, as appropriate. Write your experimental design on page 5.

Use the diagram below to help you set up your experiment. **Remember, your model fire extinguisher should only hold a maximum of 10 cc of solution. Note: 1 cc = 1 mL.**



GAS COLLECTION PROCEDURE

- A. Place the baking soda in the plastic bottle.
- B. Draw the vinegar solution into the gas collection tube by placing the stopper end of the tube into the vinegar solution and gently pulling up on the plunger.
- C. Place the end of the **gas collection tube just above the opening** of the plastic bottle without pushing the stopper into the bottle. Press down on the plunger to squirt the vinegar into the bottle. (See diagram above.)
- D. Quickly push the rubber stopper into the bottle opening, sealing the bottle so that the carbon dioxide will push the plunger up. (Caution: Do not twist the rubber stopper as you place it into the bottle.)
- E. After collecting the gas, pull straight up on the rubber stopper to remove the gas collection tube from the bottle (do not twist the stopper).
- F. Be certain to wash bottles between each trial.

3. **Show** your design to your teacher before you begin your experiment. Your teacher's approval does not necessarily mean that your experiment is well designed. It simply means that, in your teacher's judgment, your experiment is not dangerous or likely to cause an unnecessary mess.
4. **Do** your experiment after receiving approval from your teacher.
5. **Record** the results of your experiment on the pages provided. Label any tables, charts or graphs that you use. Your notes will not be scored, but you will refer to your data later when you write a report about your experimental findings. You must keep your own notes because you will not work with your partner when you write your lab report.

PART II

Repeat steps 1 to 5 to investigate the variable you choose for Part II.

Clean up your materials when you have finished your experiments. Your teacher will give you instructions for clean-up procedures, including proper disposal of all materials.

Directions for Writing Your Laboratory Report

Working on your own, summarize your experiments and results. You may use your own notes that you took previously while working with your partner. Space for your report is provided on the following pages in this booklet. You will have approximately 30 minutes to complete your report.

Your report should include the following:

- **A clear statement of the problems you investigated.** Include a clear identification of the independent and dependent variables that were studied.
- **A description of the experiments you carried out.** Your description should be clear and complete enough so that someone else could easily replicate your experiments.
- **The results of your experiments.** Tables, charts and/or graphs should be used where appropriate and should be properly labeled. Space for your data is provided on pages 16 and 17.
- **Your conclusions from the experiments.** Your conclusions should be fully supported by data.
- **Comments about how valid you think your conclusions are.** In other words, how much confidence do you have in your results and conclusions? Any factors that contribute to a lack of confidence in the results or conclusions should be discussed. Also, include ways that your experiment could be improved if you were to do it again.